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Crying: A Biopsychosocial Phenomenon

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Abstract:

This contribution describes the present state of research and theory concerning human crying. Different theories originating from various disciplines and perspectives are briefly summarized. In addition, we provide insight into the development of crying behaviour from early childhood to adulthood. We further present a comprehensive model of adult crying, which conceptualizes crying as a complex interaction of psychobiological, cognitive and social processes. The model differentiates between eliciting factors, which may be real events, memories or thoughts that trigger crying, from predisposing factors that influence one's vulnerability to cry. In addition, the model distinguishes between the possible effects of the act of crying itself on the individual and the indirect effects brought about by the reactions of the social environment, which may offer support or disapproval. Special attention is devoted to the explanation of gender differences in crying and whether crying improves mood and health.

1. Introduction

When compared to the large scientific literature on emotion, surprisingly little is known about crying. When one scans through the growing number of specialized journals that cover emotion, only rarely does an article reveal new theories or findings concerning crying. One will look in vain in indices of the major textbooks on emotions for terms such as crying, weeping or tears. Searching literature databases with these terms mainly yield studies among infants. Crying in adults remains largely unexplored.

Crying can best be defined as a complex secretomotor response that has as its most important characteristic the shedding of tears from the lacrimal apparatus, without any irritation of the ocular structures. It is often accompanied by alterations in the muscles involved in facial expression, vocalizations and in some cases sobbing – the convulsive inhaling and exhaling of air with spasms of the respiratory and truncal muscle groups (Patel 1993).

The shedding of emotional tears is a universal, typically and uniquely human way of expressing emotions. It permeates our lives from the very

beginning (“the primal scream”) until the end, when we die. During the course of our lives, our most important emotional events without exception are typically accompanied by tearfulness, whether they be positive (e.g. weddings, the birth of a child or successful performances) or negative events (e.g. loss of beloved persons or cherished goods, or failing important events). However, as we will see later, most crying actually occurs in reaction to trivial and even fatuous events. This implies that, in addition to the event that elicited the crying, other factors, such as individual differences and situational characteristics, also play an important role in crying behaviour.

A first remarkable aspect of weeping¹ is that, like blushing, this emotional expression appears to be unique to *homo sapiens*. Although one can read occasionally about crying in non-human animals, more systematic data, including interviews with veterinarians, zoologists, directors of zoos and animal trainers (Frey 1985), suggest that the evidence that non-human animals shed emotional tears is weak at best. Another notable aspect of crying is that it co-occurs with several qualitatively different emotions. While we only feel the butterflies in our stomach when we are in love and the trembling of our knees when we experience fear, crying and blushing, in contrast, seem to be associated with a wide variety of emotions, even opposite in valence.

The current contribution gives an overview of contemporary knowledge concerning crying. We will first discuss the different scientific conceptions of crying that can be identified in the scientific literature. Subsequently, the focus will be on the nature of crying and why only humans shed emotional tears. Subsequently, we will address crying in infants and its developmental aspects, as well as gender differences. Next, we will explain the biopsychosocial model of crying introduced by Vingerhoets, Cornelius, Van Heck and Becht (2000) and its different components: antecedents, moderators, and the intra- and inter-individual consequences. We will conclude by emphasizing the need for further research and put forth some suggestions.

1 Although there may be some subtle differences between the terms, we will use here the terms “crying” and “weeping” as synonyms.

2. Scientific Conceptions

There have been a remarkably large number of theories of crying, which can be classified in many ways. For example, theories may be qualified according to their backgrounds, which may include ethological, anthropological, psychological, psychoanalytic, physiological or biochemical. Alternatively, Borgquist (1906) was the first to emphasize a global distinction between theories that focus on the communicative function of crying and its effects on the environment and theories stressing the psychobiological aspects of crying and its potential effects on an individual's physical and mental well-being. A distinction can be made between reductionist theories, in which crying is reduced to its supposed physiological or biological essence (cf. Darwin 1872, Frey 1985, Montagu 1959), and "ecological" views of shedding tears, which recognize that crying is not merely a response of the lacrimal glands, but rather a response of the whole individual, in all its physiological, behavioural, cognitive and social complexity (cf. Reynolds 1924). Other theories may be labelled as psychoanalytic (e.g. Heilbrunn 1955; see also Kottler 1996, Löfgren 1966, Sachs 1973) or psychological/cognitive (e.g. Efran & Spangler 1979, Labott & Martin 1988).

Darwin (1872), probably the most prominent exponent of the reductionists, considered tears as a, more or less, useless accompaniment to muscular contractions around the eyes. These contractions serve a protective function of preventing the facial muscles, especially around the eyes, from becoming too engorged with blood. Just like blushing, tears were thus also regarded by Darwin as an exception to the rule that purposeless behaviour and body structures are not maintained during the course of evolution. On the other hand, Darwin acknowledged that crying is helpful, at least for small children, to attract the attention of caregivers when in distress. In addition, he noted that crying might be helpful in bringing relief "in much the same way as writhing of the whole body, the grinding of the teeth, and the uttering of the piercing shrieks, all give relief when one is in intense pain" (Darwin 1872: 175). Following Darwin's ideas closely, Montagu (1959, 1981) hypothesized that tear production originated as a protective mechanism, preventing a rapid drying out of the mucous membranes of the nose and throat. Since tears also contain the antibacterial enzyme lysozyme, Montagu posited that the capacity to cry with tears has reduced the risk of contracting upper respiratory infections, and in that way, has contributed to the survival of our species.

A more recent variant of reductionist views has been proposed by the American biochemist William Frey, who is a pioneer in modern crying research. Frey's (1985) focus on the biochemical aspects of crying sharply contrasts with many of the (social) psychological models of crying. In his opinion, the main function of crying is the removal of toxic waste products that build up when people are in distress. Frey further postulated that the removal of these substances has an effect on one's mental state. In other words, crying is thus conceived of as an active excretory process which helps to detoxify the body (with tear glands as equivalents of the kidneys) resulting in a better mood.

Psychoanalysts have also been active in proposing theories of crying, though these theories have been less useful for empiricists since they are difficult to test. For example, Heilbrunn (1955) argued that crying symbolizes regression to an intrauterine state. This author additionally emphasized the symbolic extension of crying from washing away painful irritants by tears to washing away painful states of the individual. Others (see Kottler 1996) have regarded crying as a compensatory defense against other internal drives such as the discharge of aggressive or sexual impulses (Löfgren 1966, Sachs 1973). Of special interest, and probably the best known of psychoanalytic theories of crying, is the notion that crying is a kind of hydraulic/overflow process, comparable to a "safety valve" (e.g. Breuer & Freud 1968 [1895], Koestler 1964, Sadoff 1966). In this view, tears represent the overflowing of emotions that have passed a critical level, preventing the excessive build-up of emotions. The process of crying thus drains off energy mobilized during distress.

Also drawing upon the idea that tears represent a release of tension, Crile (1915) and Bindra (1972) both conceptualized tears as reflecting emotions and feelings that cannot be resolved through actions but can be relieved only in biological processes that result in an overflow of tears. Tears are therefore considered as serving to discharge tension in situations where the individual is not able to cope adequately. Interestingly, the idea of the safety valve corresponds well to the concept of displacement behaviour in animals, which also has been thought to result from energy originating from a different source that is blocked from its normal expression (Kortmulder 1998, Troisi 2002). Animal displacement behaviours, such as grooming activities, scratching and yawning, have also been hypothesized to serve a communicative function to other members of the species, as well as to relax tension in the individual (e.g. by the release of endogenous opioids). A major difference, however, is that displacement activities involve "normal" behaviours, which are functional

when conducted in the appropriate context, whereas crying is a special behaviour that seems to be designed for certain specific conditions.

A number of theorists have stressed the communicative functions of crying. For example, Kottler (1996) regarded crying as a specific method of interaction with the environment, with an emphasis on communication, even drawing a parallel with language. In this reasoning, tears are considered powerful communicative signals which may have many different meanings (see also Collins 1932). A number of authors, including Kottler (1996) and Roes (1990), argue that crying in infants, and perhaps in adults as well, mobilizes help from others in emergencies (see Hendriks, Nelson, Cornelius & Vingerhoets 2008 for a review). Nelson's (2005) conceptualization of crying as an attachment behaviour that is maintained throughout one's adult life also converges on the theme of crying as communication.

Also relevant to the communicative function of crying, Frijda (1986) considers crying as a sign of helplessness and powerlessness. According to this view, the person expresses his or her willingness to surrender and to give up through crying, akin to the symbolic white flag. Central in this view is the notion that crying indicates the person's inability to cope with the situation. Interestingly, the British philosopher Thomas Hobbes voiced similar views as early as 1650 (see Lutz 1999). In addition, as just discussed, both Crile (1915) and Bindra (1972) view crying as a way to release energy that cannot be worked out behaviourally. Frijda further emphasizes the social interactive aspects of crying in that shedding tears may help to strengthen the mutual bonds between people and induce sympathy, empathy and comfort. Although crying generally draws others in, crying also has the potential to elicit strong negative reactions and irritation from others, when it is perceived as a form of a manipulation (Frijda 1997).

Some perspectives have emphasized that crying not only transmits information but also can be a powerful manipulative behaviour that influences others in one's social environment. For example, Roes (1990) suggested that the sight of tears may inhibit impulses of potential aggressors. There is some speculation that this may be related to the fact that crying adults look more like infants. Indeed, within ethology, the "Kinderschema" has been found to be powerful in strengthening the bond between parent and child and evoking feelings of tenderness (cf. Eibl-Eibesfeldt 1997).

A number of theories of crying strongly emphasize the role of cognition in the antecedents and consequences of crying episodes. For example, Efran and Spangler (1979), in their two-factor theory, propose that crying

results from a reappraisal of the factors that induce arousal, leading to a resolution of emotional conflict. Two factors take a central position in this theory: (1) the induction of arousal, which causes an imbalance in emotional equilibrium; and (2) an event or cognitive reappraisal facilitating the recovery of emotional equilibrium. Crucial to this theory is the transition from arousal to recovery. Tears are hypothesized to flow specifically in the second phase of this process (i.e. during the phase of recovery or tension reduction). The onset of crying is hypothesized to occur when the individual feels that the worst is over. This point in a crying episode may be manifested in the body when parasympathetic activity replaces sympathetic arousal.

In conclusion, there are a large number of different theories of crying, which appear to touch upon disparate aspects of this complex phenomenon. Indeed, one problem in this area of research concerns the lack of an integrative theory. With this goal in mind, Vingerhoets & al. (2000) presented a comprehensive, biopsychosocial model of crying. This model differentiates between “eliciting” factors, which may be real events, memories or thoughts that trigger crying, as well as “predisposing” factors determining one’s crying threshold. In addition, the model distinguishes between the possible effects of the act of crying itself on the individual and the indirect effects brought about by the reactions of the social environment, which may offer support or disapproval. Because the model presented by Vingerhoets & al. (2000) may have utility for guiding research on crying, it will be discussed in more detail below. Before turning to this model, however, we will briefly overview the nature of crying, its possible uniqueness as a human behaviour and how the behaviour develops in humans.

3. The Nature of Crying

When studying crying, one basic and fundamental question is whether there are qualitatively different kinds of crying. Some authors (e.g. Nelson 2005; Ryde, Friedrichsen & Strang 2007; Williams & Morris 1996) make such distinctions. From a psychophysiological point of view, this does not make any sense. Just as there are no different kinds of sweating, goose flesh or blushing, there are also no different kinds of crying. The example of sweating is of particular interest, because the tear glands have been proposed to have evolved from specialized sweat glands. Thus, in some sense, crying is a kind of excessive sweating of the eyes.

One way that crying be physiologically differentiated is if there are differences in the biochemical composition of the tears in different crying situations. Indeed, Frey and his colleagues (1981) have reported that emotional tears contain more protein than irritant tears (e.g. evoked by onions). However, our attempts to replicate that finding with modern, much more sensitive assay methods have been unsuccessful. But if the biochemical composition of these two kinds of tears do differ, one might further examine whether tears seemingly associated with different emotions (crying for positive versus negative reasons) also differ in composition, or if the tears shed by depressed individuals, or others suffering from psychopathology, differ from the tears of healthy individuals.

However, if one defines crying in a broader sense, including the behavioural aspects, it may be possible to differentiate between different types of crying, although it might be difficult to make a distinction between quantitative and qualitative differences. Most compelling to us is the distinction made by the American social worker Judith Nelson (2005), who distinguishes two or three qualitatively different types of crying with different functions. Basing herself on John Bowlby's (1960, 1961, 1980) attachment theory, Nelson considers crying to be an attachment behaviour that is maintained throughout adulthood. According to her theory, crying is basically designed to signal to others that we are in distress and need help and care. The central idea is that, when an adult experiences loss (e.g. the death of a close one or a romantic break up), the stages of grief globally parallel the reactions to traumatic separations in infancy, identified by Bowlby. The first phase is characterized by loud, persistent screams aimed at undoing the event that triggered the crying and restoring the lost or threatened person or object. This protest crying is very loud and irritating, making it an urgent signal unlikely to be missed. The aim is clear: to let everybody know that one is not happy with the separation, and one should fix the situation by being immediately reunited. In contrast, the second phase is characterized by sad crying, which functions for another purpose: shaping new attachment bonds after a loss. This type of crying predominantly signals a state of helplessness. It occurs when all efforts to undo the situation were in vain and the child feels powerless and involves a more silent and chaste crying. This is the kind of crying that evokes our sympathy – it is especially designed to elicit pity, comfort and care. It is tempting to speculate that the exposure to this kind of crying stimulates the release of the hormone oxytocin in observers, which has been postulated to promote attachment and increase trust in others (e.g. Carter 1998; Zak, Kurzban & Matzner 2005). Finally, when there is no re-

union with the lost object or person and no adequate replacement is available, the individual may reach a stage of detachment in which she or he no longer cries. Detached reactions to loss in adulthood are characterized by a lack of tears and represent extreme hopelessness, dejection and withdrawal, which are sometimes also associated with symptoms of severe depression and sadness (Nelson 2005, Vingerhoets & al. 2007). Future research should give more attention to this interesting idea of different kinds of attachment-related crying.

4. Crying as a Uniquely Human Behaviour

As mentioned earlier, tearful crying for emotional reasons is likely unique to humans. The notion that crying is uniquely human is rather old. A remarkable demonstration of this conviction is the fact that in Renaissance Europe suspected witches and werewolves were requested to cry in order to prove their human nature. Those who failed to shed tears on demand were judged to be non-human or under the control of demons (cf. Ebersole 2000).

It has been suggested that crying behaviour originates from the audio-visual communication system designed to maintain maternal-offspring contact, which can be observed in a variety of mammals. The so-called “separation cry” is thus considered perhaps the earliest and most basic mammalian vocalization, serving to promote and maintain contact between mother and child, as well as between members of an affiliated group. Separation cries (also referred to as isolation or distress cries) are produced by all mammals, sometimes in the ultrasonic domain (e.g. in the case of small rodents, probably as a protection against predators). This might also explain why in human infants physical separation from parents is an important determinant of crying, as well as why crying is highly prevalent in conditions such as separation anxiety and homesickness (Borgquist 1906, Thurber & Walton 2007, van Tilburg 2006).

MacLean (1987), primarily through research on squirrel monkey vocalizations, examined the neurobiological foundations of crying, finding that the thalamocingulate division of the limbic system (the core of the emotional brain) has become increasingly important in the course of evolution for both crying and laughter. Despite common neurobiological origins shared with other animals, emotional tearing appears to be unique to *homo sapiens*.

An intriguing question is why shedding tears for emotional reasons would be unique to humans. Evolutionary biologists (see Kottler 1996) developed the following explanation. In the course of the evolution, our brain started to grow rather rapidly, which at some point began to cause problems for the birthing process, because the skulls were becoming too large to pass through the birth canal. As a consequence, the gestational length would have been shortened in order to make birth possible without endangering the lives of the child and mother. In other words, according to this theory, humans are actually born prematurely. Indeed, compared to most other primates, we are for a very long time extremely helpless and dependent for our survival on others. Given this extended period of dependency, it is of utmost importance to utilize a behaviour that is very effective in alarming care providers and stimulating them to offer the necessary care or help. A bimodal signal, just as the alarm signals carried by emergency services, is probably most effective in this respect. Alternatively, as discussed before, Montagu (1959, 1981) has pointed to the positive effects of the transition of tearless to wet weeping for survival.

5. Crying in Infants

In attachment theory, crying is considered an important attachment behaviour, with as its most important function promoting the physical presence of a care provider (Nelson 2005). Infants mainly cry not only when they experience pain or other discomfort (e.g. due to wet diapers, hunger, fatigue), but particularly when they are aware of the absence of the mother. In cultures where babies are carried continuously by the mothers, babies cry significantly less than in western cultures, where soon after birth they are physically separated from the parents and spend much of the time in separate rooms and carriages, lacking the physical contact with the mother.

The crying of infants is probably more than just an alarm signal to elicit the attention and proximity of caregivers. Crying also carries information about the health of the infant. For example, some evidence indicates that the acoustical characteristics of sick infants' crying differ significantly from those of healthy infants' crying (Furlow 1997, Soltis 2004). Most notably, infants with a compromised health status (e.g. neurological disorders, disturbed metabolism and infectious diseases) cry at a higher pitch than normal babies. Whereas normal crying is in the range of

300–600 Hz, crying of infants with health problems typically is in the over 600 Hz range (Furlow 1997). The crying signal thus provides the parents with information about the health status, or in evolutionary terms, the fitness, of the baby. In prehistoric times, this would be particularly relevant, because from an evolutionary point of view it does not make sense to invest time and energy in offspring that are unlikely to forward their genes to future generations. Although little human research has addressed this issue, Mann (1992) demonstrated in studies of twins that mothers react faster to the crying of healthy infants than of those with a compromised health status.

To summarize, crying in human infants appears to have two major functions. First, it is a signal of distress (i.e. an alarm call) stimulating others to provide support. Second, crying serves as an indicator and source of information concerning the infant's health status and likelihood of future survival.

6. The Development of Crying in Children

As infants grow into children and then adolescents, there are three important developments in crying behaviour: (1) a strong decrease in the crying frequency, (2) noticeable changes in the antecedents of crying that elicit tears, and (3) a remarkable differentiation between the sexes, with women becoming more frequent criers than men (Zeifman 2001). Since one of the main functions of infant crying is communication, it is understandable that there is a strong decrease in crying when the child develops other ways to express needs through speech. Indeed, as children grow older and can increasingly express themselves through language, there is a noticeable reduction in crying frequency. How crying subsequently develops during childhood is mostly unknown. Whereas there is ample research addressing several aspects of crying in infants, there is almost no research on crying during the pre-school years.

With the development of cognitive processes and increasing awareness of the separateness of other human beings' cognitions and emotions (i.e. "theory of mind"), there are major changes in the reasons for crying in children. Specifically, young children only cry for egocentric reasons (e.g. pain, separation, unfulfilled basic needs etc.). Later in their development, children may also cry due to anticipation of negative consequences from others (e.g. punishment after having told a lie), or, once they have developed the capacity to understand and identify with the emotions ex-

perienced by other people, for empathic reasons. With advanced age, symbolic – in the broadest sense of the word – stimuli (e.g. poems, novels, films, music) become increasingly important as antecedents of crying.

Among infants, males and females do not differ in how often they cry. If any difference exists in young children, boys rather than girls cry more often (Vingerhoets & Scheirs 2000). This may be related to the fact that boys more often suffer from (slight) neurological and physical disorders, which predispose them to experiencing more discomfort and distress, resulting in tears. In addition, boys are often more likely than girls to be involved in exploration of their surroundings and rough play, which puts them at greater risk of minor and major accidents and injuries. On the other hand, some research findings suggest that the crying threshold of female infants is generally lower than that of boys (see Delp & Sackeim 1987).

The lack of data obtained during school-age years makes it difficult to ascertain exactly when the gender difference in crying frequency develops. Frey (1985) hypothesized that the gender difference manifests itself during puberty, with the onset of menstruation in adolescent girls, which is associated with increases in the hormone prolactin, which may lower the threshold to shed tears. However, the preliminary data that we have collected gives no clear indication that menarche is associated with a significant change in weeping behaviour: same-age menstruating and non-menstruating girls did not differ in reported crying frequency (van Tilburg, Unterberg & Vingerhoets 2002). This study further yielded data suggesting that the difference in crying between boys and girls develops before puberty. This would imply a role of not only biological, but also other (social and psychological) factors.

During childhood there are also parental and peer influences that mould the child's crying behaviour. For example, boys may more likely be discouraged, or even ridiculed, by their parents and peers when they cry, whereas for girls, it is more tolerated and accepted when they let their tears go. Just as any other behaviour, crying is also subjected to the laws of operant conditioning, meaning that crying will occur more often in the future if it is rewarded or reinforced, whereas non-reinforcement or any negative consequences will reduce the frequency of crying. In a way, the anticipated harms and benefits of crying may help distinguish globally between two kinds of tears. First, there are tears which are shed in response to a particular emotional or painful event. In addition, tears may be shed because of the anticipated positive consequences (e.g. less anger in parents, sympathy, comfort). A final important factor for the de-

velopment of crying concerns the individual's socialization and social learning processes, such as the kinds of situations and stimulation the child seeks versus the situations that are avoided (e.g. the choice of hobbies, professional interest, which books are read and which films and television programs are watched). Analyses of the antecedents of crying reveal that often there is a link with one's everyday activities (Vingerhoets, Boelhouwer, van Tilburg & van Heck 2001). Gradually, crying develops into the "adult" patterns for shedding tears.

It is interesting to wonder whether these changes in frequency and antecedents of crying as children develop into adults also imply that the function of crying changes over time. Some authors suggest that the signal function of crying is maintained during one's lifetime (Nelson 2005), but clearly more comparative work is needed. For example, virtually no research has considered whether there are differences in the crying characteristics of healthy and sick adults. Nor are we aware of any studies analysing the acoustical features of adult crying and the extent to which these features are similar to, or different from, child and infant crying. On the other hand, the popular idea that crying serves cathartic purposes and helps to maintain one's emotional balance has primarily (if not to say exclusively) been proposed with reference to adults, and has not been tested in younger criers. In this respect, the popular literature seems to suggest that, during the course of development, crying acquires an important new function: catharsis. Later on, we will discuss this issue in depth.

7. Gender Differences in Adult Crying

There is little doubt that women cry more frequently and generally for a longer duration than men. Vingerhoets and Scheirs (2000) have identified fourteen studies which apply different research methodologies comparing the crying of men and women. In every case, women reported crying more easily and more often than men. This has also been established in a rather unique study in which lacrimal flow was assessed when the participants were requested to generate imagery of sad or happy events in their lives and to re-experience the associated mood (Delp & Sackeim 1987). Both sexes reported lower mood in the sadness condition than in the elation condition. However, only in the females, lacrimal flow tended to increase following the negative mood induction and significantly decreased following the positive mood induction. Thus, these results strongly suggest that women have a lower threshold to shed tears.

It is clear that women cry more readily than men; however, it is not clear why this is the case. In order to obtain a more complete understanding of the basis for this important sex difference in crying, it is useful to describe several different stages that are involved in the process of crying. More precisely, at least the following four aspects of crying deserve critical consideration when one wants to obtain a better insight into the background of group differences in crying in general, including gender differences: the exposure to emotional stimuli, appraisal of stimuli, social learning and crying threshold.

First, one should ascertain to what extent there are differences in the *exposure to emotional stimuli*. Women are less reluctant than men to engage in emotional situations. Despite all emancipation, there are still typical "male" and "female" professions, with, generally spoken, the typically female professions (e.g. nursing) having a higher risk of exposure to emotional events. Furthermore, in leisure time, the sexes differ in the kind of stimulation they are interested in. For example, women may be more likely to watch tear jerkers or read sentimental novels or poems, while men prefer to spend their leisure time with watching and reading about other topics, such as sports, cars and computers (Kottler 1996).

Second, the focus should be on possible differences in the *appraisal of stimuli*. For example, women may apply less filtering to emotional situations than men. More specifically, when being exposed to emotional stimulation, men are more inclined to use denial or distract themselves, attempting to reduce the emotional aspects. In other words, the differences in appraisal of stressors may explain gender differences in emotional reactions (see Lash, Gillespie, Eisler & Southard 1991).

Third, there are possible differences in *social learning*. As already discussed, crying is reinforced (positively or negatively) by reactions of parents and peers. Ross and Mirowsky's (1984) study suggested the importance of adherence to traditional gender role patterns for crying behaviour in men. Specifically, men in more traditional roles appeared to cry less frequently than those who defined their gender role more flexibly. The willingness to cry during sadness was found to be high in women, intermediate in non-traditional men, and low in traditional men. Since there is a connection between educational level, socioeconomic status and less traditional role patterns, one may expect that highly educated men will cry more often. According to Kottler (1996), currently a reverse development can be seen in women in higher status occupations, who would be less prone to crying than women in general. Plas and Hoover-Dempsey (1988) have provided preliminary data demonstrating that

one's professional context may have a strong influence on whether or not one cries. Kottler (1996) further asserts that therapists and nurses are professionals who cry often, whereas engineers, stockbrokers, soldiers and doctors rarely cry. However, it is not clear to what extent these statements are based on systematic observations or are just personal impressions.

Finally, there might be differences in biological make-up, including factors that influence the *crying threshold*. Given a certain stimulus, whether or not an individual will cry seems to largely depend on his or her antecedent physical and psychological state. For example, when one feels tired or is sleep-deprived, tears tend to flow more easily. The same probably holds when one has used certain drugs, e.g. cocaine (Zarkowski, Pasic, Russo & Roy-Byrne 2007) or when one is in distress due to a chronic psychological burden. In such conditions, even clearly insignificant stimuli might be sufficient to elicit tears. It is tempting to speculate that hormones (e.g. prolactin and testosterone) and neurotransmitters (e.g. serotonin, dopamine) play a significant role as determinants of our crying threshold. Moreover, there is evidence that sadness is associated with different brain structures in men and women (Schneider, Habel, Kessler, Salloum & Posse 2000), which perhaps may also partly explain differences in crying between men and women.

8. A Model of Adult Crying

In the model of adult crying that we have developed, this behaviour is conceptualized as a complex interaction of psychobiological, cognitive and social processes (see Figure 1). Following cognitive models of emotion (e.g. Frijda 1988), we assume that emotions result from an individual's appraisal of memories and events in his or her environment. Appraisal refers to the process of judging the personal significance of events for good or ill (Arnold 1960). They are a function of objective physical and social features of situations, as well as of features of the individual. The latter include, among other things, one's current emotional state, goals and ambitions, previous experiences in similar situations, as well as evaluations of one's ability to cope with the situation (i.e. "secondary appraisal"). Emotions can be differentiated by the patterns of appraisal that initiate them (Frijda, Kuipers & Ter Schure 1989). For example, perceived injustice generally evokes feelings of anger, perceived losses are associated with sadness, and perceived threats most likely induce fear.

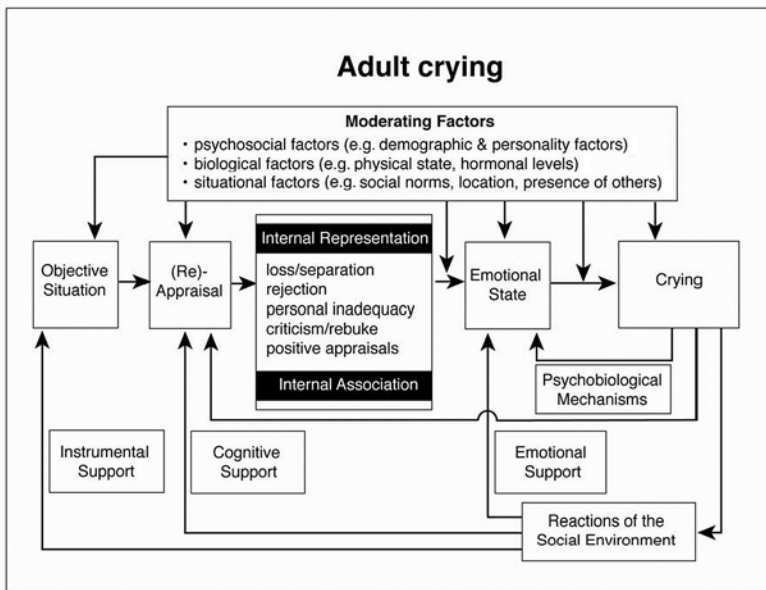


Figure 1: A model of adult crying.

These appraisals put into motion what might be called emotion programs, which are patterned, biologically and socially-based collections of responses that include physiological, expressive, experiential and behavioural components, each of which may have functional significance (Nesse 1990). These components have been characterized by Gross and Muñoz (1995) and others as *response tendencies* to highlight the fact that they may be modified or modulated (e.g. exaggerated, diminished or even entirely inhibited) before they are expressed as observable behaviour, self-reports of emotion or physiological changes. This modulation of emotion, in turn, may involve a variety of physiological, situational and personal factors. Because of this, the linkages among the various components of emotion in humans tend to be rather loose (see Averill 1980).

Crying may be regarded as a physiological and expressive response that is typically elicited by a number of different cognitive appraisals (see below for a detailed discussion of the antecedents); however, in some cases, for example when listening to music, crying can occur with surprisingly little cognitive processing. Whether or not a person will cry when exposed to a particular emotional stimulus is further moderated by a number of personal (e.g. self-monitoring status, physical state, personality) and sociodemographic factors (e.g. gender, age) as well as a va-

riety of situational factors (e.g. the presence of others who are crying, the salience of social norms concerning crying). Note that these moderating factors may also determine whether or not an individual will be confronted with certain emotional situations (e.g. in some cultures social rules require that one attends funerals of particular persons and expresses one's sadness in certain ways). Additionally, these same factors may influence one's appraisal processes (e.g. optimists probably will cry less frequently than pessimists, because they are less inclined to appraise events as negative or seriously threatening). So-called display rules, imposed by the culture one lives in, or the reactions of the social environment (e.g. disapproval inducing shame) may also be important regulators of the expression of emotions. A well-known example concerns the very specific ways to express sadness in certain non-western cultures. This is done, for example, not only by crying and screaming, but also by rubbing one's head with ashes, wearing burlap clothes, or denuding one's breast and beating on it.

The act of crying subsequently may have an impact on the psychobiological processes in the crying individual him/herself and may facilitate physiological and psychological recovery, by as yet unknown mechanisms (see below). At the same time, crying is likely to elicit particular positive or negative reactions from the social environment (Cornelius 2001; Hendriks, Nelson, Cornelius & Vingerhoets 2008). According to the model, these reactions from others may have consequences at three different levels. First, it may alter the objective characteristics of the situation (e.g. by eliciting sympathy or reducing aggression in an antagonist during an argument). In addition, crying may result in increased cognitive support, by its effects on primary and secondary appraisal (e.g. when the crying individual is made aware that one can also look at the situation from a different perspective and that his/her current appraisal of the situation is not justified). Finally, physical comforting behaviours (such as the arm around one's shoulder), kind words and other signs of empathy and understanding may directly influence one's emotional state.

In short, crying is an emotional response that basically can be conceptualized in much the same way as any other emotional expression. This raises the crucial question regarding which specific elements of crying make crying different from other emotional expressions. One aspect seems to stand out in this regard: its presumed association with qualitatively different emotions. However, this also holds for blushing which is associated with embarrassment as well as unwanted or unjustified positive attention (Leary, Britt, Cutlip & Templeton 1992) and, concerning crying, the inability to act behaviourally may be the common element

in all conditions that trigger the onset of tears. But on the other hand, crying is probably unique because of its ontological development and the notable impact of the cultural environment, although in that respect it is important to make a distinction between ritual crying in a public setting and the crying alone in one's private home (Good-Delvecchio & Good 1988). Following our model, the remainder of this article will focus on the antecedents and the consequences of crying as well as some of the moderating factors that influence this behaviour.

9. Antecedents of Crying

When examining the antecedents of crying, there are at least two important types of antecedents to consider: (1) events and situations or (2) feelings. To gain purchase on this issue, we asked study participants to remember their last crying episode and to report both what happened and how they felt. In addition, we collected information about the context, including place, time and presence of others. Findings using these methods are summarized in Table 1.

Table 1:

Attributed causes of most recent crying episodes (%) for men and women separately, and for the total group (N = 5715).

Attributed causes of most recent crying episodes	Men	Women	Total in %
Loss	29	24	27
Conflict	14	23	19
Witnessing suffering	18	14	16
Personal inadequacy	10	11	10
(Witnessing) positive events	17	7	12
Psychological state	9	11	10
Physical state	2	3	3
Combination of causes	5	8	6

First, the findings reveal that loss experiences, conflicts, witnessing suffering, perceived incompetence and (witnessing) positive events are the most common reported situational antecedents of adult crying. But these results are qualified by some interesting sex differences. Women

cry relatively more frequently during conflicts than men, whereas men cry relatively more often because of positive reasons and tender situations. The difference in the valence of the situations is further emphasized by the self-reported emotions and feelings. Men are thus more likely than women to report positive feeling states as antecedents of crying. By contrast, women are more likely to report crying when feeling angry. Note, however, that sadness and anger are two sides of the same coin, because these affects are induced by similar events, which only differ in terms of who or which agent is responsible for the situation. In this regard, the importance of powerless (or inability to act behaviourally) also deserves special attention, because this is often mentioned in relation with other feelings. In particular, women relatively often report feeling angry and powerless. But combinations with other emotions are also reported: one reportedly feels angry *and* powerless, or sad or fearful *and* powerless.

10. Positive Emotion as an Antecedent of Crying

Several research findings concerning the antecedents of crying thus seem to indicate that humans can shed tears for negative as well as positive reasons. However, there are theorists (e.g. Feldman 1956, Weiss 1952) who argue that people are inaccurate when they report they are crying for positive reasons, since negative reasons are lurking beneath the surface. There is at least substantial anecdotal evidence to lend credence to this assertion. To give some examples: when the Dutch horsewoman Anky van Grunsven was asked why she cried when standing on the platform with her Olympic Gold medal, she answered that her tears had to do with the fact that her father had passed away some months before, and she was sad because she could not share this moment of extreme happiness with him. According to other crying gold medal winners, their tears were associated with reflecting on painstaking efforts to qualify, or the problems they had encountered in the process of qualifying themselves (e.g. because of diseases or serious injury). Likewise, crying during an ostensibly positive reunion event may be seen as the consequence of reflecting on the less happy times when the people who meet, missed each other so badly. Feldman (1956) presents many other examples showing that crying at the happy ending arises from a number of causes, which in some way involve negative emotion. The negative emotion may be due to delayed reaction to sad events (for example, one first realizes how one missed another when seeing him or her again), the memory of which is

awakened by a happy ending, or to guilt. Additionally, it is suggested that in adult life the individual can no longer experience the happiness and the parental protection of childhood. Feldman further points out that we cry not only over past unhappy events, but also because the happy childhood with its illusions is gone, and we cry for the sad end which is sure to come – the separation from the beloved ones. In other words, when people are very happy, they seem to allow themselves to remember less fortunate times and experiences which evoke their tears.

Finally, another conception that raises doubts concerning whether unalloyed happiness is an antecedent of crying, sees crying as resulting from helplessness and an inability to express happiness in an appropriate way. Being overwhelmed by the joy, one does not know how to behave, what to do and what to say.

In conclusion, there are some good reasons to hesitate before accepting the idea that negative and positive emotions have co-equal power to evoke tears. A more parsimonious explanation that views all crying in terms of negative emotion and/or perceived helplessness or an inability to act adequately might well be possible.

11. The Context and Social Setting of Crying

Scrutinizing events that are associated with crying has also yielded some surprising insights about the kinds of antecedent events that trigger crying. In the great majority of cases, the eliciting situations proved to be rather trivial and fatuous. It is often hard to imagine that such stimuli or events triggered the onset of tears. To give some examples, respondents shed tears because the postman failed to deliver an anticipated letter, or because they experienced problems when sewing curtains, or during a dancing class when failing to master some dancing steps. These examples demonstrate that we cry most frequently for reasons that do not rank very high in their objective impact as potential tear eliciting events. In contrast, events with a strong objective potential to elicit tears only seldom really induce tears, because such dramatic events as deaths or romantic break-ups do not occur frequently. This observation further emphasizes the relevance of the concepts “crying threshold” and “predisposing factors”, as well as the importance of environmental factors, which may explain why sometimes very weak emotional stimuli suffice to elicit tears, while at other moments people can, seemingly, without too much effort, withhold their tears in spite of having encountered rather dramatic

events. The factors that have been suggested or found to be associated with crying frequency and/or crying proneness are numerous. Individual differences in crying may be related to:

- Sex
- Temperament (personality)
- Attachment style
- Socialization
- Physical state
- Psychological state
- Drug use (e.g. cocaine)
- Confrontation with stressful / traumatic life events
- Being engaged in a romantic relationship
- Transition to parenthood
- Neurological disorders

Studying the contexts in which people cry revealed that tears are predominantly shed when at home (or in one's car), either alone or just with one other person. What does this reveal about crying? Perhaps that we are not very eager to express our emotions through tears when we are in the company of others, particularly strangers. This reluctance to cry in public may stem from the fact that crying can be interpreted in many different, positive, but also negative ways. In addition, crying may induce shame and embarrassment, if one feels that the situation does not justify the shedding of tears. We may fear that others notice our weakness and perceive us as emotionally unstable and not in control of our emotions. In addition, there is the risk that the tears are conceived as a kind of manipulation. These factors may make us rather reluctant to cry in the presence of others because it may be damaging for our image.

Weeping occurs especially during the evening, more precisely between 6:00 PM and 10:00 PM. Why do we cry more frequently during evening hours? This might partially be related to the reasons why one tends to cry alone or with one other person. We are inhibited in our crying when we are at work or in public places, with many others around us. There also seems to be a general tendency to delay our tears until a more quiet moment in a safe environment, alone at home or just with our partner. Rosenblatt (2004) portrays several examples of crying while driving, which fits nicely with these insights. The interviewed individuals often spontaneously report that they started crying first when alone in their car. Another significant factor may be that evening hours are the time

that we are together with our partner and children and have our quarrels and rows with them, which can precipitate crying. In addition, during these evening hours, we may be exposed to other stimuli that may induce tears, including TV programs, news or movies, books and music. Moreover, the threshold to weep may be lowered in the evening, because we are tired after a day of hard work. Finally, it has been established that infants are also more prone to cry during evening hours, which might suggest that adults may also retain an endogenous circadian rhythm that facilitates evening crying.

Comparing crying in different countries additionally demonstrated that people in cold countries cry more frequently than people living in warm countries, with the correlation between crying frequency and average annual temperature being -0.75 . This strong negative association between crying frequency and average annual temperature was remarkable and rather unexpected, because previous research has revealed that people in warmer countries are more emotionally expressive (Pennebaker, Rimé & Blankenship 1996).

In an attempt to explain this apparent paradox, we have put forth the following possible explanations. First, it may be that the higher emotional expressivity may prevent the escalation of conflicts and the crying that may result from these conflicts. Alternatively, these findings may be related to differences in personality, temperament or mood. It is well-known that in the northern countries there is a higher prevalence of depression, partly due to the limited exposure to sunlight. In addition, it may relate to the fact that people in warmer countries generally spend more time until rather late out on the streets and in public places, whereas in cold countries one is more often at home, alone or just with intimates, engaging in activities such as watching sad movies and listening to emotional music. In order to evaluate this hypothesis, we compared self-reported crying behaviour of Dutch people in summer and in winter, anticipating that more frequent crying would be reported in winter than during summer. Although there was indeed a slight trend towards more crying during the winter period, the difference was not statistically significant. This left us with the question concerning the precise role of the other factors discussed above, which still has to be ascertained. One should be aware, however, that temperature is not the only dimension on which these countries differ. There are strong associations with other potentially relevant factors, including Gross National Product (GNP), freedom of expression and many others. These relationships deserve further exploration.

12. The Consequences of Crying

Whereas our research efforts initially focussed on the antecedents of crying, developmental aspects, sex differences and social context, the research was subsequently expanded to examine the effects of crying. In line with how the effects of emotion are typically discussed, we distinguish between the *intra*-individual effects (what are the consequences for the crying person him- or herself) and the *inter*-individual effects (the effects of crying on others) in terms of others' perceptions, moods and behaviours.

12.1 The Inter-Individual Effects of Crying

According to Ekman (1997), facial expressions of emotion provide information about at least the following seven well-differentiated domains: (1) possible antecedents, that is to say, the events that generated the emotion; (2) possible memories, thoughts and plans; (3) internal physical changes in the person who experienced the emotion; (4) the expression may serve as a metaphor that defines the emotion expressed; (5) information regarding what the person is about to do next; (6) expectations from others in the person's presence; and (7) semantic information in the form of an emotional word. As far as is known, there is no research addressing all these issues with regard to crying.

Specific with respect to crying, several theorists have suggested that the primary function of crying is to stimulate others to help remove a given source of discomfort, as well as to elicit attention, empathy and support from others (Frijda 1997, Kottler & Montgomery 2001, Nelson 2005, Sadoff 1966). As such, adult crying can be regarded as an attachment behaviour, which is thought to be designed especially to elicit caregiving responses from significant others (Bowlby 1969; Hendriks, Nelson, Cornelius & Vingerhoets 2008; Nelson 2005). Attachment research has indeed shown that crying is an inborn behaviour that functions to call for and assure the protective and nurturing presence of caregivers (Bell & Ainsworth 1972, Bowlby 1969, Cassidy 1999, Zeifman 2001), and it has been proposed that tears continue to be an attachment behaviour throughout life (Bowlby 1969, Nelson 2005).

Along these lines, Wagner, Hexel, Bauer and Kropiunigg (1997) demonstrated that, in response to a crying patient, doctors, nurses and medical students primarily try to soothe the patient with words, hold the hand of the patient and/or become personally affected. When Wagner and co-

workers asked hospital staff how colleagues responded to their tears at work, it appeared that health professionals were, for the most part, either comforted or left to themselves. However, a significant portion (approximately one-fifth) of the medical students reported that they were ridiculed, screamed at or looked at with contempt.

In addition to these real-life reports, some quasi-experimental studies have been carried out. For example, in the study by Hill and Martin (1997), confederates (in this study, only women) acted as if they were crying or not crying in reaction to a film. The results showed that crying confederates elicited more sympathy and more crying from the participants (also only women) than did non-crying confederates. Hendriks, Croon and Vingerhoets (2008) examined reactions to vignettes describing different situations in which the main character either cried or did not cry. The respondents reportedly tended to give more emotional support and expressed less negative affect towards a crying than a non-crying person.

Hendriks and Vingerhoets (2006) examined the so-called signal value of crying faces, i.e. the social messages they convey to others. To this end, they compared reactions to crying faces with reactions to neutral, angry and fearful faces. Respondents reported being more likely to provide emotional support to a crying person and less likely to avoid a crying person in comparison to people with other emotional expressions.

In some older studies, it has been shown that men and women may differ in their reactions to crying persons (Cretser, Lombardo, Lombardo & Mathis 1982; Jesser 1989). For example, a crying man was more likely to be helped by female than by male respondents. Furthermore, he was more looked down on by male relative to female respondents. However, in more recent studies (Hendriks & Vingerhoets 2006; Hendriks, Croon & Vingerhoets 2008), the sex of the respondent and of the crying person did not substantially influence the social reactions to crying.

The majority of the studies examining social reactions to crying support the attachment perspective on adult crying (Hendriks, Croon & Vingerhoets 2008). As expected, crying generally elicited sympathy and support, and crying individuals were perceived as communicating the message that they are in need of help. However, also some evidence was found for negative reactions from the social environment in reaction to tears, though these negative findings do not necessarily contradict the attachment-theory perspective (see Nelson 2005). Protest crying can evoke feelings of guilt and irritation in others, who subsequently may express their anger or frustration. Also, people who cry out of sadness may evoke feelings of awkwardness in potential caregivers, which may result

in their pulling away. The sex of the potential caregiver might partially determine the amount of awkwardness that is experienced in the presence of a crying person. Because women are more comfortable with intimacy and a nurturing role, they may experience fewer feelings of awkwardness in the presence of crying individuals than men. This might explain why women tended to react with sympathy and support while men tended to feel irritated and confused in the presence of a crying person (Cretser & al. 1982, Jessor 1989). It should also be noted that negative feelings induced by the observation of crying individuals might motivate observers to undertake some action to make the crier stop shedding tears. In other words, helping crying individuals and providing them with emotional support may not only result from mere altruistic motives, but also from ego-centric reasons (Hendriks, Croon & Vingerhoets 2008).

Hendriks, Croon and Vingerhoets (2008) further demonstrated that reactions from the social environment to crying were partially determined by the situation or context in which the person cried. Whether or not others perceive the crying as appropriate might be especially relevant in this regard. Anecdotal evidence suggests that tears that are considered inappropriate rather than genuine or manipulative may evoke strong negative reactions and may even be considered as blackmail (Frijda 1997, Kottler 1996). As an example, crying on the job is often considered as inappropriate (Hoover-Dempsey, Plas & Wallston 1986), which might explain the findings of Wagner & al. (1997), discussed earlier, that crying medical students sometimes received negative reactions from their colleagues.

Further, it is tempting to speculate about possible physiological changes in observers of crying persons. Currently, there is increasing research interest for the neurohormone oxytocin, which has established functional roles in birth, lactation, parenting and some forms of positive social interactions. Based on this hormone's function, we would expect that crying might stimulate the release of this substance in observers, which would, in turn, stimulate caregiving and support behaviour from others just as the crying of babies does in (breast feeding) mothers. This would then be a nice example of how reactions of adults are built on and integrated into evolutionary older brain structures and functions (Carter 1998).

12.2 The Intra-Individual Effects of Crying

Concerning the intra-individual effects of crying, it is not difficult to collect quotes from popular media expressing the view that crying brings immediate relief and promotes health, whereas inhibiting one's tears would

increase the risk of a wide variety of health problems (see Lutz 1999, Vingerhoets & Bylsma 2007). In particular, in the articles published after 1950, the classic psychosomatic point of view (see Groen 1957) was popularized. Specifically, crying was considered to be an important means for releasing physiological tension. If this tension was not released by crying, it might find an outlet in another less wholesome manner, for instance, by resulting in bodily disease. Headaches, ulcers, hypertension and insomnia were mentioned as examples of disorders that might result from the failure to cry. Similarly, more recent popular publications often reference Frey's (1985) idea that tears help to remove toxic waste products that are released when we are in distress.

Similar opinions have been voiced in the scientific and clinical literature. For example, Darwin (1872: 174) pointed out that "children, when wanting food or suffering in any way, cry out loudly (...) partly as a call for their parents for aid, and partly from any great exertion serving as a relief". He even suggests a dose-response relationship, as evidenced by the following comment: "And by as much as the weeping is more violent and hysterical, by so much will the relief be greater, – on the same principle that the writhing of the whole body, the grinding of the teeth, and the uttering of the piercing shrieks, all give relief under an agony of pain" (Darwin 1872: 175). This suggests that the more intense the crying, the greater the benefit to one's health. Similarly, Breuer and Freud (1968 [1895]: 8) refer to tears in their *Studies on Hysteria* as involuntary reflexes that discharge affect so that a "large part of the affect disappears". The famous British psychiatrist Sir Henry Maudsley (1835–1918) has been attributed the statement that "Sorrows which find no vent in tears may soon make other organs weep." Other examples of the conviction that crying is healthy and beneficial can be found in Menninger, Mayman and Pruyser (1964) who noted that crying may be considered perhaps the most human and most universal of all relief measures. In addition, Mills and Wooster (1987: 125) described crying as a "vital part of a healing or growing process that should not be hindered". A final example concerns Solter (1995: 28), who considers crying "an inborn healing mechanism".

Despite the historical eminence of these voices, contemporary empirical studies have not yielded strong evidence that crying is beneficial for physical and psychological health. Vingerhoets and Scheirs (2001) and, more recently, Vingerhoets and Bylsma (2007) have extensively reviewed the relevant literature and come to the conclusion that the quality of most studies showing health effects is poor. Most studies showing positive evi-

dence for the relationship between crying and health are case studies, use retrospective designs or lack adequate control groups. In addition, as we will show below, some studies even have yielded evidence against the hypothesis that crying brings relief and promotes health.

Concerning the effects of crying on one's mental well-being, mixed results have been reported, depending on the design of the study and the characteristics of the participants. Quasi-experimental laboratory studies exposing subjects to sad films have mostly found a negative effect of the shedding of emotional tears; nearly without exception did people who cried while watching a sad film feel sadder and more depressed afterwards than individuals who failed to cry (Cornelius 1997; Stougie, Vingerhoets & Cornelius 2004). In contrast, when asking respondents to remember their most recent crying episode and to report how they felt afterwards, 35–70 % report mood improvement and a similar percentage indicate that there was no significant mood change, with just a minority of 10 % indicating that their crying had a negative impact on their well-being. It is not clear how to explain these discrepant findings. Possible explanations focus on the possibility that memory biases distort the reporting of retrospective crying episodes, or the fact that, in real life, crying may have an impact on the situation and the social environment, which is less likely to occur when one watches a movie in a laboratory setting, lacking social support that would generally occur in a real life setting (Cornelius 1997). Furthermore, the inadequate timing of the measurements (for example, one could argue that the positive effects of crying need some time to develop) or the fact that crying in the laboratory may induce embarrassment may be responsible for the seemingly contrasting findings.

It may be that the context of crying is important in the experience of mood change (i.e. catharsis) after crying. Examining this question, in an international study spanning 37 countries and including over 5,500 respondents, Becht and Vingerhoets (2001) established that the general self-reported experience of post-crying mood improvement was negatively associated with the shame induced by crying. Also using data from this same set of respondents, Bylsma, Vingerhoets and Rottenberg (2008) found that self-reported mood improvement after the most recent crying episode was related to receipt of positive social reactions (e.g. comfort, support), and the experience of shame during crying was negatively related to mood improvement after crying. Furthermore, experiencing a resolution to the event that caused the crying episode or achieving a new understanding of the event was positively related to mood improvement.

13. Crying and Physical Health

Results on the immediate physical effects of crying have also been mixed. Furthermore, physical functions such as heart rate and blood pressure have not demonstrated more rapid recovery after a crying spell when exposed to emotional stimuli, compared to when no tears are shed (for a review see Vingerhoets & Scheirs 2001). On the other hand, research by Rottenberg Wilhelm, Gross and Gotlib (2003) suggests that crying in healthy never-psychiatrically-ill individuals may stimulate parasympathetic activation, which may promote physical relaxation. However, Hendriks, Rottenberg and Vingerhoets (2007) replicated this parasympathetic activation among criers, but could not establish whether the increased parasympathetic activation was the consequence of crying or, rather, preceded its onset. Two studies (Labott & al. 1990; Martin, Guthrie & Pitts 1993) examining the effects of crying on secretory immunoglobulin A (S-IgA), an immunologic variable acting as a first-line defense against invasion by potential pathogens, demonstrated that the specific act of crying appeared to have a negative influence on the body's defense mechanisms, which suggests a negative impact of crying on physical health.

On the other hand, a number of noteworthy positive findings in support of the beneficial effects of crying have also been reported, mainly in old case studies, but also some recent Japanese studies. For example, French (1939) as well as Saul and Bernstein (1941) found intriguing relationships between crying and course of urticaria (i.e. hives) and asthma. Saul and Bernstein (1941) describe a reciprocal relationship with symptom development and weeping in a female patient. Specifically, when the patient cried she did not have urticaria and her asthma attacks usually terminated with weeping. Conversely, when she suppressed her tears she developed urticaria. According to French (1939), his clinical observations led him to believe that many asthma attacks terminate when crying begins. Similarly, Kepecs, Robin and Brunner (1951) reported a relationship between crying and exudation into the skin. Using cantharides blisters under hypnosis, these authors demonstrated that the inhibition of crying was followed by an initial drop in the exudation rate, later followed by an increase, if the inhibition was continued. More recently, two Japanese studies demonstrated some remarkable effects of crying. First, among patients with rheumatoid arthritis (RA) it was found that shedding tears reduces the negative influence of stress on the neuroendocrine and immune responses in peripheral blood (Ishii, Nagashima, Tanno, Nakajima & Yoshino 2003). Patients who were moved to tears appeared to have a

more easily controlled RA compared with those who were emotionally affected but not moved to tears. In addition, Kimata (2006) reported that the allergic responses to latex were strongly reduced after crying in a group of 44 patients. Finally, Bayart & al. (1990), in a possibly relevant animal study, examined the reactions of monkeys to separation from their mothers. A remarkable finding was the negative association between plasma cortisol levels and vocalizations expressing distress. In other words, screaming was connected with reduced cortisol secretion. Assuming that human crying is equivalent to these distress reactions, it may be hypothesized that crying in humans also reduces the cortisol output of the adrenals. In sum, there is also some preliminary evidence that crying promotes the recovery of homeostatic balance within the body.

Research has additionally addressed the relationship between general crying frequency (or crying proneness) and subjective well-being or disease risk. These studies have yielded little evidence in support of the hypothesis that crying is healthy. Rather, the few available data suggest that crying is not or very weakly negatively related to one's physical well-being (for a review see Vingerhoets & Scheirs 2001 and Vingerhoets & Bylsma 2007). Vingerhoets & al. (1993) examined the relation between crying frequency and self-reported health, which yielded a correlation of exactly 0.00. Crepeau (1981) found that ulcer and colitis patients cried less frequently and evaluated crying more negatively than healthy controls, which suggests a positive association between crying and health; however, this study suffers from serious methodological flaws.

14. Crying and Psychological Health

Crying, as an expression of distress, is potentially relevant to psychological health and psychopathological disorders. Much of the work on crying and psychological health conditions has thus far focussed on depression. Although it is commonly believed that there is a positive association between depression and crying, the story appears to be more complex. To examine this relationship, Vingerhoets, Rottenberg, Cevaál and Nelson (2007) conducted a systematic examination of the relationship between depression and crying by reviewing all relevant theories and empirical data that included the performance of crying items in measures of depression. Scores on crying items of depression inventories correlated moderately with overall depression severity. Otherwise, there was surprisingly little evidence for the widespread claim that depression is associated

with more frequent and/or easier crying. There was also little empirical support for the competing claim that severely depressed individuals lose their capacity to cry. On the one hand, Rottenberg, Gross, Wilhelm, Najmi and Gotlib (2002) failed to demonstrate that depressed patients were more likely to cry when being exposed to a sad movie; but on the other hand, Rottenberg, Cevaal and Vingerhoets (2008), using validated crying measures, showed that (compared with the reference group) patients with mood pathology reported increased cry proneness to negative antecedents, but no differences were found with respect to crying proneness to positive antecedents. Patients additionally reported less mood improvement after crying than did controls.

Assuming that crying brings relief and improves mood under certain conditions, one may wonder about the relevant psychophysiological mechanisms involved. We have identified the following four hypotheses. The first idea, just described, is that crying stimulates the activity of the parasympathetic nervous system. This branch of the autonomic nervous system – the counterpart of the sympathetic branch which is associated with stress and activity – is connected with relaxation and recovery. Consistent with this hypothesis, Rottenberg & al. (2003) and Hendriks, Rottenberg and Vingerhoets (2007) found that crying was indeed associated with increased parasympathetic activity. A second possible mechanism that received attention in the literature is Frey's (1985) proposition that tear glands are analogous to kidneys in removing toxic waste products, including stress hormones released in the blood during distress. Cleansing the blood of these substances results in a better mood and perhaps even better health, according to Frey. However, it appears that the amount of toxic waste products removed by tears is negligible, and tears are, to a great extent, again reabsorbed in our nasal passages. Further, one would expect that crying induced by irritants, such as onions or tear gas, would also have a positive effect on one's well-being, which does not appear likely. A third notion is that sobbing increases the amount of inspired cold air, which may result in the cooling of the hypothalamus, a very important structure in the emotional brain. There is some evidence that a lowered brain temperature has a positive effect on mood (McIntosh, Zajonc, Vig & Emerick 1997). Finally, one could speculate that crying promotes the release of substances such as endorphins, which are morphine-like substances that are released in the brain, which function to increase pain tolerance and improve mood (see also Panksepp 1998). As far as is known, this hypothesis has never been directly tested, but this seems an interesting and testable hypothesis.

To summarize, although the research is limited, very different approaches thus far failed to have yielded strong support for the idea that crying induces mood improvement and facilitates recovery from emotional distress. What seems more likely is that crying stimulates others to provide social support, providing indirect benefits. Cornelius (1997, 2001) and Nelson (2005; see Hendriks, Nelson, Cornelius & Vingerhoets 2008 for review) emphasized that the benefits of crying may come not so much from actually shedding tears, but rather because tears bring us physical contact and solace from others, and it is well known that emotional support has a positive effect on our physical and mental well-being.

15. Conclusion

The present article provides a state-of-the-art overview of contemporary research on adult crying. It can be concluded that this phenomenon is largely ignored in the current scientific literature. It is likely that, in the past, crying was merely considered as an expression of sadness or other emotions; therefore, it was wrongly not considered an interesting phenomenon in itself. Most studies published until now are not typically theory-guided, originate from disparate theoretical backgrounds and are disconnected from one another.

One thing that makes crying a special, intriguing and interesting phenomenon is that it may serve several different functions. Barr, Hopkins and Green (2000) edited a book on infant crying with the title *Crying as a Sign, a Symptom, and a Signal*. This is indeed a catchy title, adequately representing the different multifaceted sides of (infant) crying. When considering adult crying, one may further add that crying can serve different coping functions: problem-focussed coping, because it may influence the behaviour of others (e.g. aggression reduction) and emotion-focussed coping (if it indeed would have a stress reduction function). For a full and adequate understanding of the importance of this behaviour, one should have an open eye for the many diverse aspects of this typical and intriguing human behaviour. In an effort to capture the multi-faceted nature of crying, we have described the model developed by Vingerhoets & al. (2000) and Vingerhoets and Cornelius (2001) to guide future research efforts.

In the future, in addition to speculation about the evolutionary origin of crying and the precise nature of the crying response, more theory-guided, well-designed studies should focus on antecedents, moderators and

consequences of crying. More specifically, the study of the antecedents of crying should include research into situations and feelings that may elicit crying. The consequences encompass both the intra- and inter-individual (psychological, behavioural, psychobiological and social) effects of crying. As important moderators, one may consider cultural aspects, age, gender, mental and physical state.

In short, the field of crying research can best be described as scattered, incoherent and lacking a systematic approach. It is a field that badly needs the collaboration of experts with different backgrounds including developmental, clinical, social, biological and cross-cultural psychology. In addition, the contribution of neurobiologists and ethologists may help to obtain more insight into the evolutionary nature and functions of crying. Until now, most research understandably has relied on self-reports. Crying is a rather rare behaviour, that is not easily induced in ethically acceptable ways. Work on crying would be enriched by naturalistic observations of crying behaviour. Work that includes physiological recordings would also be informative. For example, Delp and Sackeim (1987) measured lacrimal flow with the so-called Schirmer test, when asking the study participants to generate imagery of sad or happy events in their lives and to re-experience the associated affect. The manipulation did not influence the lacrimal flow in men; however, women showed an increase in the sad condition and a decrease in the happy condition. This is an interesting example of how crying can be examined with more objective research methods. Thus, many challenges remain for creative researchers with different backgrounds to analyse this intriguing, typically and uniquely human behaviour.

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